No. 6

PINK BOLLWORM INFORMATION

COOPERATIVE RESEARCH ON THE PINK BOLLWORM AND RELATED COTTON INSECTS

ENTOMOLOGY RESEARCH CENTER
AGRICULTURAL RESEARCH SERVICE, U.S.D.A.
BROWNSVILLE, TEXAS

P I N K B O L L W O R M I N F O R M A T I O N

NO. 6

INTRODUCTION

This annual report was prepared earlier than the last one which was issued August 1, 1957. Its earlier distribution was necessary in order that it would be available for use by members of the Pink Bollworm Technical Research Committee and the S-37 Regional Project Committee on Pink Bollworm Control which meet at Brownsville, Tex., on June 23-24, 1958.

Current pink bollworm research consists of a single coordinated program conducted by Federal and State agencies participating in Regional Project S-37. Progress made by these agencies during the last year is summarized in this report. Also, there is included a report on the status of the regulatory program, prepared by the Plant Pest Control Division.

PLANT PEST CONTROL DIVISION
(Report by: Southern Region)

I. Infestation

At the end of the 1957 crop year, the pink bollworm situation appeared more favorable than it had in many years. Substantial gains were made in the reduction of field population from that found the previous year. Perhaps the most outstanding improvement noted during the year was the great reduction in infested areas as well as the reduction in intensity of population in the states of Arkansas and Louisiana where eradication programs are in progress. The infested area in Arkansas was reduced from 14 counties in 1956 to 1 county in 1957, while in Louisiana it was reduced from 6 counties to 5. Only two pink bollworms were found in Arkansas in spite of the more intensive gin trash inspection than has ever before been made in the history of the program.

In 1956, 541 counties in 14 states were inspected and 295 of these were found infested. Of this number 207 counties in 4 states were classed as having threatening, severe or heavy infestations. In 1957, 608 counties were surveyed and 238 counties were found infested with only 136 in the "threatening-severe-heavy" classification.

The 1957 inspection results are summarized below and in the attached status map.

	Number of counties inspected						Total counties	
State	Negative	Trace	Light	Threatening	Severe	Heavy	Inspected	Infested
Alabama	59	0	0	0	0	0	59	0
Arizona	5	1	0	2	0	0	8	3
Arkansas	53	1	0	0	0	0	54	1
California	10	0	0	0	0	0	10	0
Florida	18	2	0	0	0	0	20	2*
Georgia	53	0	0	0	0	0	53	0
Louisiana	48	4	1	0	0	0	53	5
Mississippi	63	0	0	0	0	0	63	0
Nevada	2	0	0	0	0	0	2	0
New Mexico	3	0	6	4	1	0	14	11
Oklahoma	13	12	14	0	0	0	39	26
Tennessee	10	0	0	0	0	0	10	0
Texas	33	15	46	44	58	27	223	190
Totals	370	35	67	50	59	27	608	238

* Wild cotton on the Coast.

II. Damage from Pink Bollworm in 1957

Economic damage occurred only in localized areas of south and central Texas and a few fields in the San Angelo and El Paso areas of this state. Heavy populations in several of the south Texas counties caused some loss in grade.

III. Stalk Destruction

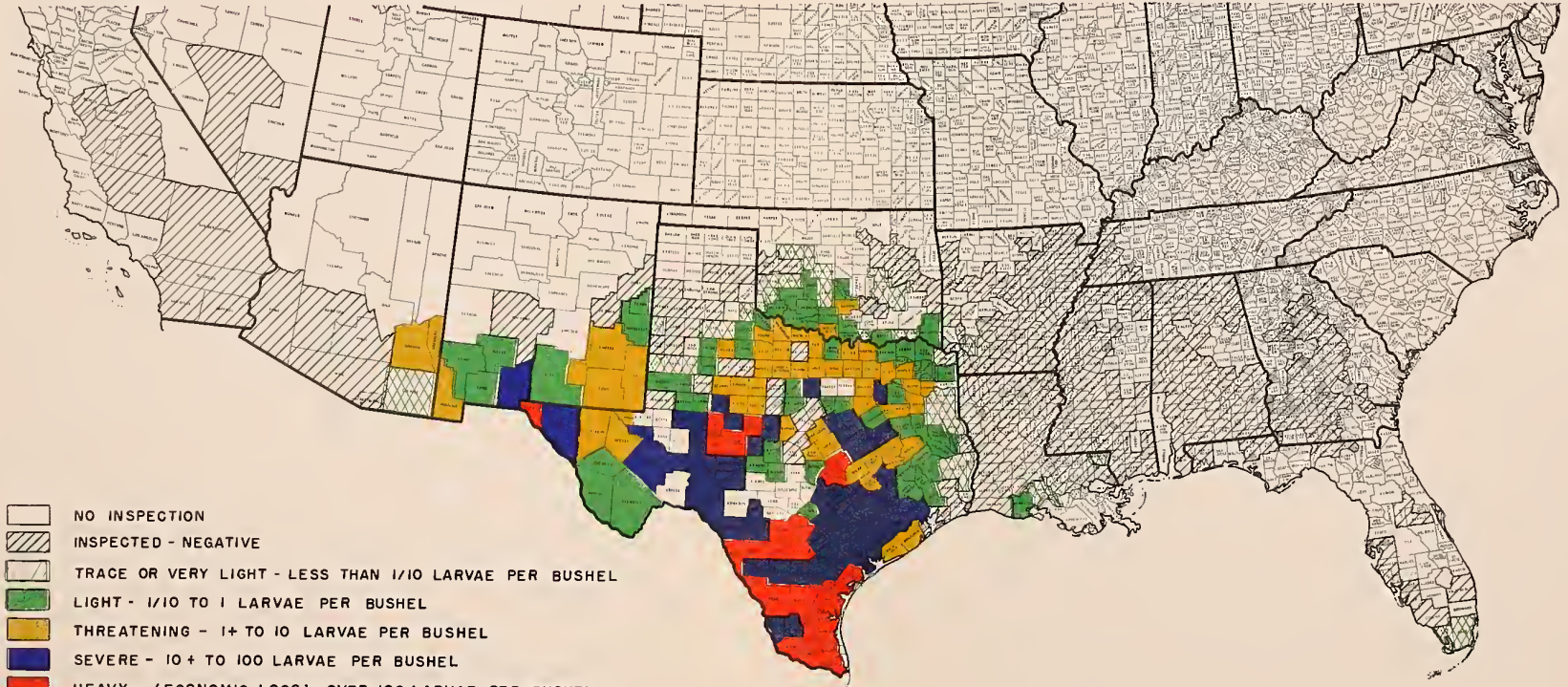
In 106 counties of Texas, 29 counties in Arkansas, and 19 parishes in Louisiana, where mandatory deadlines for stalk destruction completion are in effect, delays occurred due to unfavorable weather which was rather general throughout the entire cotton area. Considerable emphasis was given to compliance with cultural practices around infestations in Louisiana and Arkansas, and excellent cooperation was obtained from the farmers. Sanitation measures, such as stalk destruction, have considerably aided in the fight to prevent further spread and also reduce populations in many of the counties as well as actually eliminating infestations in some of the more lightly infested counties.

IV. Regulatory

Regulatory controls, as has been the case for the past 40 years, were effective in preventing spread of the pest through movement of cotton and its products. Research studies made it possible to revise the quarantine in 1957, making the handling of some products less restrictive. This revision, effective August 31, 1957, divided the 6-state quarantined area into a generally infested area consisting of the states of New Mexico, Texas, and Oklahoma, and an eradication area including Arizona, Arkansas and Louisiana. Gin sterilizers were discontinued in the generally infested area at a considerable saving to the cotton trade, and certification was waived on movement of cottonseed meal and cake and on compressed cotton moving to any destination.

Plans for 1958 will follow the same general lines of the past years and will include strict supervision of the treatment and interstate movement of planting seed and the strengthening of traffic inspection between the generally infested area and the eradication area. An agreement has been reached with Research on a long-range plan for improving cultural controls in the areas requiring stalk destruction by leading an educational campaign to institute optimum planting dates in all such areas. It is believed that when this plan is in full effect field populations can be greatly reduced and kept in check in any area.

STATUS OF PINK BOLLWORM INFESTATIONS AS OF JAN. 1958



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ARKANSAS AGRICULTURAL EXPERIMENT STATION

Pink bollworm larvae were recovered at only two gins in southwest Arkansas during the 1957 ginning season. The decline in numbers is credited to a combination of winter cultural practices and weather conditions at the time of spring and early summer moth emergence.

In the absence of heavy pink bollworm populations the Arkansas Agricultural Experiment Station workers are most interested in the hibernation research, methods of eradication, and in cotton types that may show resistance to this pest. Timing insecticide applications to meet a combined insect threat is also under investigation.

Pink bollworm hibernation studies were continued at Mount Pleasant, Texas, and a like set of experiments was established at Heavener, Oklahoma. These experiments are in cooperation with the Entomology Research Division and, on the latter, with Oklahoma State University. Results from Mount Pleasant have been reported by the Entomology Research Center, Brownsville. This study is being continued in 1957-58. Temperature recorders have been established in three tests at Heavener and standard temperature-humidity records are being kept also.

Post harvest disposal of field residues by mechanical means was investigated in cooperation with the Arkansas State Plant Board and the Plant Pest Control Division. A Brady ensilage cutter was given limited tests for effectiveness in stalk destruction and for removal from the field all materials that may harbor diapausing larvae. It was found to be an excellent stalk shredder when adequately powered. Pick-up of materials that had fallen to the ground was good in dry fields of sandy loam type, but poor in fields of gumbo or clay type, particularly if the material had been rained on or trampled into the soil. The machine was 80 to 85 per cent effective. The remaining 15 per cent which would lie on the soil surface could prove a critical problem. A burr clover seed harvester was tested as an aid in removal of cotton residues remaining on the soil surface following use of the Brady. While not fully effective, particularly for picking up green bolls and materials that may have become entangled in the dirt, the machine showed promise. These experiments will be continued in 1957-58.

Timing applications of insecticides and of defoliants for early production and maturity and for early harvest was investigated. Adverse weather conditions reduced value of the results in this test. Defoliants showed value in reducing the availability of food in the fall on which hibernating populations may build up. Further investigation is needed before conclusions may be drawn. These tests are being continued.

Varietal resistance or tolerance to attack by boll weevil was continued with a search for lines of cotton which show resistance to or tolerance for attack. Boll weevil is used as a test animal with resistance to other pests being considered. Fifty-three lines were selected from 337 lines tested in 1957, as indicating some degree of escape resistance or tolerance.

Infestation pin-pointing was continued during the past year by the Plant Pest Control Division and the Arkansas State Plant Board, with all pin-pointed fields cleaned up. Residues were collected from a Brady cutter and burned, followed by cultivation to bury all remaining residues.

PUBLICATIONS

T. F. Leigh. 1958. The pink bollworm in Arkansas, Arkansas Farm Research, VII (2): 5, 1958.

TEXAS AGRICULTURAL EXPERIMENT STATION

1. Stalk Cutter-Shredder Tests:

Tests to evaluate the effectiveness of improved stalk cutter-shredders in reducing pink bollworm populations were conducted in cooperation with the Entomology Research Division. The tests were located in the Rio Grande Valley near San Benito. Experiments were also planned in the College Station area but were not conducted due to excessive rainfall.

A commercial Brady stalk shredder with an 80-inch swath was used in six randomized, replicated treatments. The tractor was operated in first gear.

The treatments were:

1. The stalks were shredded using the 45 degree top deflector plate.

2. Stalks were shredded as in treatment 1, but a second pass was made over the same area traveling in the same direction as the original cut.

3. Stalks were shredded with the deflector plate bolted down covering the normal top exit.

4. Stalks were shredded using the ensilage wagon spout. The material left on the ground was also picked up after the machine and kept separately from that collected from the spout.

5. Stalks were shredded as in treatment No. 1 and followed by listing. Only the debris left uncovered by the lister was collected.

6. Crop residue was collected from the plant and ground before shredding.

Boll residues were collected immediately after shredding on August 30 and caged August 31. Emergence records of pink bollworm moths were completed as of April 15, 1958.

Results, as expressed by the percentage reduction in moth emergence from shredded residues (treatments 1-5) as compared with unshredded residues (treatment 6), indicate that treatment No. 1 resulted in 96.66% reduction, treatment No. 2 in 93.95%, treatment No. 3 in 97.63%, treatment No. 4 in 97.37%, and treatment No. 5 in 99.47%. On completion of emergence records, 2,659 moths had been collected from the untreated residues (treatment No. 6), while only 161 had been collected from the least effective treatment (treatment No. 2).

In an effort to obtain more effective control of the pink bollworm with stalk shredding equipment, another experimental stalk shredder is being constructed in the Agricultural Engineering Research Shop at College Station. This shredder employs two counter rotating blades on vertical shafts, as compared to a single blade on conventional shredders. The machine will also be equipped with two cast iron corrugated rolls for crushing the stalk debris.

L. H. Wilkes, Agr. Engineer, TAES
O. T. Robertson, Entomologist, ENT

2. Evaluation of Nozzle Arrangements for Controlling Pink Bollworm with Insecticidal Spray:

Three field experiments were conducted to evaluate application methods for controlling pink bollworm under dryland and irrigated conditions. The dryland cotton received 7 applications of endrin beginning August 5 and ending September 9. Irrigated Experiment 1 received 8 endrin applications beginning August 2 and ending September 16. Irrigated Experiment 2 received 10 endrin applications beginning August 2 and ending October 4, plus 2 applications of Guthion on October 7 and 10. The endrin was applied at the rate of 0.4 pound of active ingredient per acre and the Guthion at 0.75 pounds per acre. All sprays were prepared from emulsifiable concentrates and were applied with a high-clearance sprayer.

The following nozzle arrangements were tested:

1. Boomjet (trade name). This nozzle operating at 30 p.s.i. was used to cover a 42-foot swath, or 12 40-inch rows.

2. Floodjet (trade name). This nozzle operating at 30 p.s.i. covered a swath equal to 6 40-inch rows.

3. Fieldjet (trade name). This nozzle operating at 35 p.s.i. covered a swath equal to 6 40-inch rows.

4. One No. 6 cone nozzle per row. Conventional nozzles were mounted on the boom above the row on 40-inch centers.

5. Two No. 3 cone nozzles per row. Conventional nozzles were spaced 20 inches apart on the boom.

6. Check - No spray.

Each nozzle arrangement was calibrated to deliver 6 gallons per acre.

Boll weevil and bollworm infestations were moderate throughout the test period. Pink bollworm infestations did not develop. Results indicated no differences in insect infestations or yields in the dryland experiment. There were no differences in insect infestations in Irrigated Experiment 1; however, all treatments yielded more cotton than the check but did not differ significantly from each other. Also, there were no differences in insect infestations among the treatments in Irrigated Experiment 2. No yields were taken as this field was subjected to an overflow in mid-October.

The data obtained from all experiments indicate that boll weevil and bollworm control was obtained with all the nozzle arrangements tested; however, additional testing is needed under conditions of heavy infestations.

L. H. Wilkes, Agri. Engineer, TAES
W. J. Magee, Entomologist, TAES

3. Sprayer Development:

A self-propelled high-clearance sprayer was designed and constructed in the Agricultural Engineering Research Shop at College Station. The primary objective was to incorporate certain features of conventional sprayers in a machine designed to maneuver in wet fields.

The sprayer was constructed of light weight steel tubing. Thirty-six inch O.D. aircraft tires were employed to provide more traction. The contact area of these tires on a concrete floor with 10 pounds pressure is approximately 74 square inches. The machine is powered by a 15 h.p. air-cooled engine. A variable speed "V" belt drive assembly was used to connect the engine to a 4-speed automobile transmission. Power is transmitted from the transmission, through a differential, to a right angle gear box above each rear wheel. From these gear boxes enclosed vertical drive shafts are used to transmit power, through another pair of right angle gear boxes, to the rear wheels.

Preliminary field tests with this machine have been satisfactory; however, more experience in wet fields is needed.

A J.I. Case No. 88 Tobacco Harvester was also tested in this project to investigate the possibilities of converting this type machine to a high-clearance sprayer. A 12-row boom was constructed and mounted on this machine, and it was used for applying insecticides in the nozzle test plots. The machine was satisfactory in dry fields. However, with the small rear wheels, it could not be used in wet fields. Difficulty was also encountered in the power transmission system. This machine will undergo further modification in 1958 and will again be tested.

L. H. Wilkes, Agri. Engineer, TAES
W. J. Magee, Entomologist, TAES

4. Preharvest Chemical Studies:

An experiment was conducted to evaluate nozzle arrangements for application of defoliants and desiccants. The broadjet nozzles tested were of the same types as those described in the nozzle arrangement test (section 2 of this report). The defoliants were applied as sprays with a high-clearance spray machine. Each nozzle arrangement was calibrated to deliver 12 gallons per acre. Four tests were conducted; 2 each on dryland and irrigated cotton. Additional measurements were taken with the broadjet nozzle arrangements to compare outside and inside rows.

No measurements of pink bollworm, or other insect infestations, were taken as damaging populations never developed in the plots.

Results indicated the No. 3, No. 6, and boomjet nozzle arrangements performed somewhat better than the floodjet and fieldjet nozzles. Comparison between broadjet types showed no difference between nozzle arrangements for treatment averages, and the inside rows usually had fewer leaves than the outside rows. In dryland cotton, Folex treatments of boomjet and floodjet nozzles had greater row differences than the other nozzle arrangements. In irrigated cotton, Folex treatments by boomjet nozzles had greater row differences than the other broadjet nozzles.

S. P. Johnson, Plant Physiologist, TAES
L. H. Wilkes, Agri. Engineer, TAES

5. Host Plant Resistance Studies:

Gossypium thurberi, Deltapine 15, Delta Smoothleaf, Pubscent, Pima, and G. herbaceum were used in the oviposition studies conducted in large field cages containing 6 plants of each variety.

Data obtained from this study indicated that Delta Smoothleaf was most preferred for oviposition. Thirty-two per cent of all eggs were deposited on this variety, 19% on Deltapine, 18% on Pubescent, 17% on Pima, 10% on G. herbaceum, and 4% on G. thurberi. In the early season, Smoothleaf and Pima were most attractive to the moths for oviposition while the other varieties were not extensively attacked until after fruiting began.

The tender growth of the leaf axils and terminals were the preferred sites for oviposition on all varieties before fruiting. After fruiting, the bolls and surrounding parts were favored on all varieties except Pima and G. thurberi.

Small cage tests were conducted with each variety being caged separately. Results indicated that even in the absence of other varieties, pink bollworm moths will deposit very few eggs on G. thurberi. The

descending order of preference from most to least preferred, according to the number of eggs found on each variety, was G. herbaceum (15,769 eggs), Smoothleaf (1,049 eggs), Pima (813 eggs), Pubescent (656 eggs), G. thurberi (320 eggs). Generally the axillary and terminal buds were the favored oviposition sites. However, on Pubsecent 53% of the eggs were deposited on the hirsute leaves and 17% on the stems. On the Smoothleaf, the eggs were deposited chiefly in the protected area under the calyx.

R. K. Williams, Grad. Res. Asst. Ento., TAES

6. Yield and Quality Losses Resulting from Pink Bollworm Attack:

Studies of the loss in cotton quality and yield as the result of pink bollworm attack were continued. However, the experiment in 1957 was conducted under conditions of abnormally high rainfall. All work was conducted under large field cages. Infestation levels ranged from 9.4% injured bolls with 0.98 larva per boll, to 23.9% injured bolls with 1.3 larvae per boll. There were no significant differences in seed yields, lint yields, or gin turn-out, due to pink bollworm infestatiions. The per cent bad seed varied from 4.4% in the lightest infestation to 14.3% in the heaviest infestation, with the differences between treatments being statistically significant. Analyses of seed products showed no significant differences between treatments for trash, moisture, oil, ammonia, protein, free fatty acids, grade, or value per acre. There were no significant differences in grade or staple length of lint samples taken from the different levels of infestation.

W. A. Showers, Grad. Res. Asst. Ento.,TAES
W. J. Magee, Entomologist, TAES

7. Seasonal History Studies:

From approximately 8,220 larvae caged during the winter of 1956-57, 761 adults were recovered the following spring resulting in a survival figure of 9.26%. Of the total, 708 adults emerged before June 1 and 53 after. The peak of emergence occurred from mid-May to June 2, the period when cotton normally begins fruiting in the College Station area.

R. K. Williams, Grad. Res. Asst., TAES

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Brazzel, J. R., and J. C. Gaines. 1957. Yield and quality losses caused by various levels of pink bollworm infestations. Jour. Econ. Ent. 50(5):609-13.

Brazzel, J. R., and D. F. Martin. 1958. Survival of long cycle pink bollworm larvae in the College Station, Texas, area. (In press).

Wilkes, L. H. 1957. Spray nozzles for insect control. Cotton Gin and Oil Mill Press. September 7, 1957.

Williams, R. K., J. R. Brazzel, and D. F. Martin. 1958. The effect of certain organic insecticides on the mortality and oviposition of pink bollworm adults. Jour. Econ. Ent. (In press).

PINK BOLLWORM SECTION,
Entomology Research Division

Recent realignment in the Division has brought about changes in the section dealing with cotton insects. The former Cotton Insects Section is now divided into two sections -- Pink Bollworm Section, headed by Dial F. Martin with headquarters at Brownsville, Tex., and Cotton Insects Section, headed by C. F. Rainwater, Beltsville, Md. All research on the pink bollworm is directed from the Entomology Research Center at Brownsville, but certain phases of it are conducted at the College Station and Waco laboratories of the Cotton Insects Section, and experiments are conducted in other localities of Texas and Oklahoma.

There have been considerable other changes in personnel since the last issue of this report. S. E. Jones, formerly Coordinator of Pink Bollworm Research and Station Leader of the Entomology Research Center, is now Chief of the newly-formed Field Crops Insects and Bee Culture Research Branch, with headquarters at Beltsville, Md. Dr. Jones' former duties are now assigned to Dr. Martin. T. P. Cassidy, in charge of flax insects investigations with part-time duties on pink bollworm research, has retired. Mr. A. L. Williamson and Mr. R. R. Sluss returned to school last fall to work toward the Ph.D. degree. Mr. G. T. Bottger, in charge of toxicology, was transferred to Tucson, Ariz., in March 1958 to head the Cotton Insects Section station there. Mr. C. N. Husman was transferred in October 1957 to the Animal Disease Eradication Division.

Efforts are being made at the present time to employ an ecologist, a toxicologist, and an insect pathologist to replace the above employees.

Financial support during the past year came from the Oscar Johnston Cotton Foundation, the states of Georgia and Alabama, and the Entomology Research Division.

Operation of the bioclimatic cabinets will be a Division program with various agencies participating and sharing the cost.

Insecticides for Pink Bollworm Control - ENT f3-1

DDT, currently the only insecticide recommended for pink bollworm control, continues to be the most economical. Guthion, which has been used experimentally for the last several years, is highly effective against this insect. Sevin, a new insecticide tested in the field for the first time in 1957, appears very promising. Methoxychlor, Dilan, and EPN have long been known to be effective but have not proved competitive with DDT because of cost or other reasons. Insecticide experiments conducted since the last issue of this report are summarized below.

1. Field Experiments (McGarr and Richmond)

Several insecticide experiments were conducted for control of the pink bollworm and other cotton insects. Seasonal average pink bollworm infestation records obtained in four of these experiments are shown in the table below, omitting some tests in which the infestation did not develop sufficiently for satisfactory evaluation.

Treatment	Technical insecticide per acre	Pink bollworm: Bolls infested	Pink bollworm: Larvae per boll	Boll weevil punctured squares	Seed cotton per acre: Yield	Seed cotton per acre: Gain
	Pounds	Percent	Number	Percent	Pounds	Pounds
Experiment No. 1						
Untreated check		87	7.60	66.7	150	
2½% Sevin	.55	65	3.53	38.9	545	395
5% Sevin	1.20	35	.83	16.3	1096	946
10% Sevin	2.10	5	.07	6.3	1195	1045
3% Guthion + 5% DDT	.63 + 1.10	8	.14	11.8	1092	942
2½% dieldrin + 10% DDT	.55 + 2.2	14	.27	8.4	1260	1110
Experiment No. 2						
Untreated check		80.7	2.51	30.8	800	
Guthion (spray)	.53	18.2	.33	15.6	1488	688
Endrin + DDT	.53 + 2.0	28.8	.50	17.8	1840	1040
10% Sevin (dust)	2.5	8.8	.13	5.0	1880	1080
Experiment No. 3						
Untreated check		34.7	.91	--	1906	
2% Guthion + 10% DDT	.64 + 3.0	2.0	.03	--	--	--
3% Guthion + 5% DDT	.78 + 1.3	1.6	.03	--	2566	760
10% Sevin	3.0	2.0	.03	--	2725	820
Experiment No. 4						
Untreated check		62.8	1.56	77.0	65	
4% Thiodan	.9	52.8	1.41	46.6	320	255
10% malathion + 10% DDT	2.3 + 2.3	42.4	.95	49.7	420	355

Sevin was used for control of boll weevil, bollworm, and cotton aphid in another experiment, partially financed by its manufacturer, which was conducted at Valles, San Luis Potosi, Mex., where the pink bollworm does not occur. Results obtained from these experiments warrant the following conclusions.

Sevin: When applied as dusts, 10% Sevin was equal to or better than 2.5% dieldrin plus 10% DDT or 3% Guthion plus 5% DDT for pink bollworm and boll weevil control. Sevin will control both of these insects when applied at 1.5 to 2 pounds per acre at 4- or 5-day intervals. It will control the pink bollworm at rates of 2 to 3 pounds per acre applied at 7-day intervals. At these rates, it will also control the bollworm and cotton aphid.

Guthion alone and mixed with DDT: Dust mixtures of Guthion and DDT gave very good control of the pink bollworm and boll weevil, confirming results obtained last year. Guthion spray at 0.5 pound of technical material per acre gave a greater reduction in infestations than that obtained from 0.5 pound of endrin plus 2 pounds of DDT. However, the cotton yield was higher for the endrin-DDT mixture.

Thiodan: A dust containing 4% Thiodan, applied at a rate of approximately 21 pounds per acre at intervals of 4 days, did not give adequate control of either the boll weevil or pink bollworm, and was not effective against the cotton fleahopper.

Malathion mixed with DDT: A dust containing 10% malathion and 10% DDT applied at intervals of 4 days did not give adequate control of the boll weevil in Experiment 4. Previous experiments have shown that malathion is not effective against the pink bollworm.

2. Laboratory Tests (Bottger, Lowry, and Tsao)

Experimental insecticides were tested against the pink bollworm as residual sprays on potted plants in the laboratory. Of 31 chemicals tested, 6 listed below were highly promising and it is planned to use these in field experiments in 1958 if available for small-plot tests.

Bayer 25141
Cal. Spray ML-97
Hercules 3895
General Chemical 3661
General Chemical 3707
Monsanto 7769

3. Studies of Attractants (McGough and Glick)

Chemicals that are highly attractive to the pink bollworm adult are needed for possible use in detecting incipient infestations, measuring abundance of the insect in the generally infested area, and increasing the effectiveness of insecticide applications.

Various chemicals were screened in olfactometer tests comparing their attractiveness with that of green cotton bolls to pink bollworm moths. Some 80 materials were tested in this manner at two or more concentrations. Chrysanthemumic acid, M-isopropoxybenzyl ester, has shown greater attractancy than the cotton boll and is now being used as a

standard, instead of the boll, for comparing the test materials. Several other related chemicals showed attractiveness about equal to the standard.

In similar tests, no material has been found thus far to be more attractive than the cotton boll to the boll weevil.

Biological Control - ENT f3-2 (McGough and Sluss)

1. Pathogenic Organisms

It is planned to give greater emphasis to investigation of pathogens for pink bollworm control than has been given previously. Mr. McGough was recently assigned to this phase of biological control. It is planned for the position vacated by Mr. Sluss to be filled by another employee of similar training. Work on this project since the last issue of this report has been hindered by the departure of Mr. Sluss last fall.

Cultures of 12 fungi, identified only by code numbers, were received from the Beltsville laboratory and used in laboratory screening tests. Under conditions of these tests the pink bollworm was highly susceptible to 6 of the fungi; boll weevils were also highly susceptible to 6, and the southern armyworm to 4. The salt-marsh caterpillar was less susceptible with only one of the pathogens causing as much as 50% mortality.

Nematode DD-136 was found effective against boll weevils in squares in laboratory tests but no weevil control was indicated in a small-scale field test. Field tests showed that this nematode with its associated bacterium killed 62 to 77% of gulf-white butterfly larvae on broccoli plants, and 47% of diamondback larvae on cabbage. The following insects were found susceptible to attack in laboratory tests: Larvae of the cotton leafworm, salt-marsh caterpillar, cabbage looper and southern armyworm, and adults of the Mexican fruit fly and false cucumber beetle.

In a small-scale field test, Bacillus thuringiensis Berl. gave practically 100% kill of gulf-white butterfly larvae that were in various stages of development on broccoli. It did not give any appreciable control of the cotton leafworm in a similar field test. Laboratory tests showed adult boll weevils not to be susceptible to this pathogen.

2. Parasites and Predators

Observations of a native mite, Blattisocius tineivorus Oud., indicate that it may contribute to natural control of the pink bollworm by destroying the insect eggs.

Further importation of foreign parasites is not anticipated because of the lack of accomplishments from past large-scale releases of many species, as previously reported. A small shipment of Bracon greeni, imported from India, was recently received from the Insect Identification and Parasite Introduction Laboratory, N. J. This parasite has not been released in this country, but previous attempts have been made to rear it for release. A few adults of the recent shipment were introduced into a large cage on infested cotton. The remaining breeding stock will be used in further work to develop a rearing technique, and if the number can be increased sufficiently, releases will be made.

Cultural Control - ENT f3-3 (Robertson and Shiller)

1. Pink Bollworm Survival in Relation to Depth of Burial

Infested bolls which had been held over winter in cool storage were used in a cage experiment, begun March 13, 1957, at Brownsville, to determine the effect of depth of burial on pink bollworm moth emergence. The bolls were thoroughly mixed and divided into lots of equal weight for the check and burial treatments. The check bolls were placed in 5-gallon cans with moth traps, 1 pound per can, and held in a room under conditions favorable for pupation and moth emergence. The other lots were buried 2, 4, and 6 inches in outside cages of the same type as that used in hibernation experiments. There were 3.5 pounds of bolls per cage, with 10 cages for each depth of burial. Results of this experiment are shown below.

Burial depth, inches	Number of moths recovered	Percent survival
Check	2705	--
2	1225	45
4	766	28
6	447	16

2. Other Cultural Practices

See hibernation studies, ENT f3-6, below for discussion of various fall and winter cultural treatments in cage experiments. Also see section by the Texas Agricultural Experiment Station for report on cooperative experiments to evaluate stalk shredders.

Varietal Susceptibility - ENT f3-4

No work performed on this project. The Texas Agricultural Experiment Station has leadership of this line of investigation.

Hibernation Studies on the Pink Bollworm - ENT f3-6 (Robertson, Fife, and Noble)

1. Studies in Bioclimatic Cabinets

During the last several years, pink bollworm hibernation experiments have been conducted in bioclimatic cabinets simulating conditions at widely separated localities of the uninfested areas. Results of these experiments, summarized below, indicate that the pink bollworm may survive the average winter at all localities throughout the Cotton Belt. This work in climates outside of the infested areas was discontinued at the end of the 1957 tests.

The main objective of the experiments was to determine if the insect could survive at these localities. The larval population was not sufficient to afford reliable figures for comparing the percentage survival in the different environments, due to limitations on space in the cabinets. Results of experiments conducted at Greenwood, Miss., Malden, Mo., Memphis, Tenn., and Athens, Ga., are summarized in the following table.

Locality	Year	No. larvae in each treatment	Percent survival in bolls		
			On soil surface	Buried 2 inches	Above ground1/
Greenwood	1955	445	2.47	0.22	--
	1956	570	18.60	0	76.67
Malden	1956	570	0.17	0	8.77
	1957	318	0	0	0
Memphis	1957	318	58.80	11.63	83.30
Athens	1957	318	41.19	2.51	60.10

1/ Simulating bolls on standing stalks without rainfall.

Infested cottonseed on sand in cans receiving simulated rainfall were held in other cabinets used by the Fruit Insects Section. Moths recovered from these cans showed survival at Fort Valley, Ga., Orlando, Fla., Houma, La., Tempe, Ariz., and at Compton and Sebastopol, Cal.

2. Studies at Eight Localities in Texas and Oklahoma

It has been known for many years that fall and winter cultural practices have a great effect on mortality of hibernating larvae and that this effect may vary in different localities, due to climatic conditions.

Five-Year Study of Four Cultural Treatments: The 1957 experiments ended a 5-year study in which four different cultural practices were

simulated in cage experiments conducted at seven localities in Texas and one in Oklahoma. These localities represented a wide range of weather conditions, as shown by climatological data for the 5-year period (winters of 1952-53 through 1956-57) summarized below.

Locality	Lowest winter temperature (°F)		Rainfall, beginning of tests in fall through June 30 (inches)	
	Range	Average	Range	Average
Brownsville	32 - 38	34.4	11.4 - 22.6	18.4
Port Lavaca	27 - 31	28.6	16.0 - 35.5	23.4
Waco	19 - 21	20.2	13.2 - 35.8	22.0
Greenville	12 - 19	14.0	16.0 - 57.5	28.9
Mt. Pleasant	11 - 15	13.7	19.5 - 38.8	25.5
Lubbock	3 - 9	6.2	4.3 - 16.2	7.9
Vernon	2 - 16	11.4	5.5 - 31.3	17.1
Chickasha	3 - 12	8.2	10.7 - 25.1	17.1

Pink bollworm survival varied considerably from year to year. The 5-year average results from the various treatments are summarized below.

Locality	Percent survival in bolls				
	On soil surface			On stalks	
	Buried in fall[1/]	Buried in spring[2/]	Not buried	buried in spring[2/]	Average
Brownsville	0.33	0.57	1.41	2.14	1.11
Port Lavaca	.09	.78	8.47	2.24	2.89
Waco	2.00	10.49	27.48	7.89	11.97
Greenville	2.43	4.35	7.50	1.23	3.89
Mt. Pleasant[3/]	.57	3.70	35.01	0.71	12.47
Lubbock	2.30	1.73	8.69	.03	3.19
Vernon	.47	1.28	6.48	.10	2.08
Chickasha	.77	4.29	10.50	.02	3.89

1/ Sept. 1 at Brownsville, Oct. 10 at Port Lavaca, and Nov. 15 at all other localities.

2/ Jan. 15 at Brownsville, Feb. 1 at Port Lavaca, Feb. 15 at Waco, and Mar. 1 at all other localities.

3/ 4-year average.

Of the four treatments, fall burial caused the highest mortality at localities with mild temperatures--that is, at Brownsville, Port Lavaca, and Waco. In the localities with colder winter temperatures--that is, Lubbock, Vernon, and Chickasha, the mortality was highest in bolls above ground simulating standing stalks. The climates at Greenville and Mount Pleasant appear to be such that the mortality is highest in bolls above ground for some years, while in other years it is highest in bolls buried in the fall. Fall burial increased mortality above that for bolls remaining on the surface until buried in

the spring at all places except Lubbock where there was no significant difference. Mortality was lowest in bolls that remained on the soil surface throughout the experiment at all places except in the subtropical climate at Brownsville where the lowest mortality occurred in bolls kept above ground during the fall and winter.

In interpreting these results, as they may apply under field conditions, consideration must be given to the proportion of infested bolls on the stalks or soil surface following harvest. Practically all waste bolls where a stripper has been used are left on the soil surface. Where cotton is harvested by hand or machine pickers, the amount of waste cotton and the proportion on the soil surface may vary widely. In a cold climate immature bolls may not contribute to the overwintering population even though heavily infested. Such watery bolls are easily frozen and the larvae killed if there is a sudden freeze following warm weather.

Two- to Three-Year Study of Other Treatments: Experiments in progress during the last 3 years at Lubbock indicate that a preplanting irrigation stimulated pink bollworm pupation, resulting in a decreased mortality in dry springs, but increased mortality in the unusually rainy spring of 1957. Three-year averages indicate a slightly higher mortality from January 10 burial than from November 15 burial at Lubbock and Chickasha. Results of a 2-year study of mortality in relation to date of burial at Waco (bolls buried 2 inches on September 15, October 15, November 15, December 15, and February 15) indicate that mortality decreased with delay in date of burial. Experiments in progress at Mount Pleasant for the last 2 years show some effects of winter cover crops on pink bollworm mortality; however, differences between the 2 years necessitate a longer study to obtain conclusive data as to effects of the date of plowing under the cover crop.

3. Tests at Other Localities with New Technique

Experiments were initiated at Beaumont, Nacogdoches, and Texarkana in the fall of 1955 and at Kirbyville and Tyler in the fall of 1956. Infested bolls were exposed, under various treatments, during the winter and then moved to Brownsville for moth emergence in cans held under conditions favorable for pupation. This method has an advantage of being economical but may not prove to be satisfactory since the results thus far have been erratic, possibly due to experimental technique. It appears that after completion of the current tests, the data should be reviewed to determine whether or not continuation of these experiments is warranted.

Pink Bollworm Abundance and Distribution - ENT f3-7 (Various staff members and Plant Pest Control Division)

This subject is discussed in the Plant Pest Control report, pages 2 and 3. For the last several years much of the work carried out on this line project has been more or less incidental to other field studies. Except in the Lower Rio Grande Valley, infestation decreased considerably throughout Texas in 1957 compared to 1956, and serious damage occurred on only a small acreage. Although there was an increase in degree of infestation in the Lower Rio Grande Valley in 1957, the infestation level still remained far below the 1952 level which was the highest ever recorded for the area. Bloom inspection during May 1958 indicates a heavy infestation in some fields in the Lower Rio Grande Valley.

Alternate Host Plants - ENT f3-10 (Shiller and Fife)

The finding of new pink bollworm hosts since the last report accounts for only two new plant species, Acacia wrightii Benth. (Tree catclaw) and an undetermined Hibiscus species. The insect is now known to propagate on 38 plant species other than cotton, representing 4 families and 20 genera, growing under natural conditions in this country. It is known to live from one cotton-crop season to the next on 26 of these hosts. The more favorable hosts belong to the genus Hibiscus. Okra is probably next to cotton in the insect's preference, and must be considered in the same category as cotton from the standpoint of quarantine regulations. Experimental plantings of kenaf showed that this plant is also near cotton in attractiveness. Many other species of plants become rather heavily infested when growing in close proximity to cotton.

Wild host plants and plants used as ornamentals, either because of their lack of abundance or attractiveness, appear to be of negligible importance in building up the pink bollworm population to attack cotton. However, the pink bollworm may survive on these plants, making them of primary importance in a program for eradicating the insect by means of a noncotton zone or a cotton-free period.

The species found infested under natural conditions in this country are listed below with an asterisk placed by those found to carry resting larvae over the winter in seed pods.

Malvaceae:
*Abutilon incanum (Link) Sweet
*Abutilon lignosum (Cav.) Don
Abutilon trisulcatum (Jacq.) Urban
*Althea rosea (L) Cav. - Hollyhock
Callirhoe linearriloba (T&G) Gray
*Gossypium thurberi Todaro - Thurber cotton
Hibiscus sp.
*Hibiscus abelmoschus L. - Muskmallow
*Hibiscus cannabinus L. - Kenaf

*Hibiscus cardiophyllus Gray
*Hibiscus coccineus Walt - Scarlet Rosemallow
*Hibiscus esculentus L. - Okra
*Hibiscus lambertianus HBK
Hibiscus lasiocarpus Cav. - Woolly rosemallow
*Hibiscus militaris Cav. - Scarlet rosemallow
Hibiscus mutabilis L. - Cottonrose hibiscus
*Hibiscus rosa-sinensis L. - Chinese hibiscus
*Hibiscus syriacus L. - Shrub althea
Hibiscus tubiflorus D.C.
Kosteletzskya althaeifolia (Chapm.) A. Gray
*Malachra capitata L.
Malva parviflora L.
Malva sylvestris L.
Malvastrum coromandelianum (L) Garcke
Malvaviscus arboreus Cav. - South American waxmallow
*Malvaviscus drummondii T&G - Drummondii waxmallow
*Pseudabutilon lozani (Rose) Fries - Lozano false abutilon
*Sida cordifolia L.
*Sida spinosa L.
*Thespesia populnea (L) Correa - Portia tree

Euphorbiaceae:
*Croton capitatus Michx. - Goatweed
*Croton texensis (Kl) Muell. Arg. - Goatweed
*Ricinus communis L. - Castor bean

Leguminosae:
Acacia wrightii Benth - Tree catclaw
*Daubentonia punicea (Cav.) DC - Coffee bean (Sesbania punicea)
*Gleditsia triacanthos L. - Honey locust
*Prosopis chilensis (Molina) Stutz - Mesquite

Convolvulaceae:
*Ipomea crassicaulis (Benth) Robinson - Bush morning glory

The pink bollworm was found to develop on five other plant species when moths were caged over the plants, or eggs were placed on the fruiting forms. These species are as follows:

Abutilon theophrasti Medic.
Abutilon umbellatum (L.) Sweet
Anada cristata (L.) Schlect
Cienfuegosia sulphurea (St. Hill) Garcke
Linum usitatissium L. - flax

Defoliation and Herbicide Investigations - ENT f3-11

No work performed on this project. The Texas Agricultural Experiment Station has leadership in this line of investigations.

Physiology - ENT f3-13 (Clark, Williamson, and Richmond)

1. The Effects of High Temperature on the Adult Pink Bollworm

The results of preliminary work have shown that there are numerous factors which must be studied before an accurate picture can be obtained. The age of the individual adults is very important as the mortality varies inversely with the age, i. e., a group of moths 1 day older than another group was killed by one-fifth less heat. Differences in humidity are imporrant as it took less heat to kill the moths when the humidity was high. Temperatures of 46° C. or higher caused immediate heat rigor and subsequent somatic injury resulting in paralysis, the extent of which varied inversely with the amount of applied heat. At higher temperatures it was very difficult to determine mortality because of complete paralysis. The moths recovering from this paralytic state were very inactive for the rest of their life. Temperatures above 55° C. for 2 minutes caused 100% mortality.

2. Respiratory Studies of the Pink Bollworm

These respiratory studies have been carried out in a Warburg apparatus. The insects used were all confined to keep their activity at a comparable level. In most cases the individuals' respiration was followed for a period of 8 to 48 hours. However, in the case of approximately 30 diapause larvae the rate was measured for 1 month. The fourth-instar nondiapause larvae were mature and had finished feeding.

The results of the measurement of the oxygen consumption of various stages of the pink bollworm can be found below.

Average weight and oxygen consumption of the pink bollworm at 82° F.

Stage	Wt. (mg)	$mm^3 O_2/hr/mg$
Egg	0.7	3.8
Larvae		
2nd	2.2	1.2
3rd	6.1	3.1
4th	20.1	4.5
4th diapause	28.7	0.2
Adult	10.1	1.1

An examination of the above data disclosed several differences. The oxygen consumption, and hence metabolism, of the eggs and fourth-instar nondiapause larvae were the highest. There was a factor of 26x between the nondiapause and diapause fourth-instar larvae, neither of which were in a cocoon. Also, there was only a difference of 0.02 mm^3/hr/mg oxygen uptake between the diapause larvae without cocoons and those in cocoons. There were no differences in the rate between the sexes.

The low oxygen consumption of the diapause larvae is indicative of their quiescent state and is undoubtedly the reason for their ability to survive adverse conditions such as being submerged in water or under soggy soil where the partial pressure of oxygen is either nil or exceedingly low.

The average weight of the various stages has been included to show the great differences that exist between the third- and fourth-instar larvae and between the fourth-instar larvae and the adults. The differences in weight between the nondiapaused and newly-diapaused fourth-instar larvae are quite significant also. It might be pointed out here that this difference diminishes with the age of the diapaused larvae until the difference is negligible. (See ENT f3-16)

3. Observations of the Pink Bollworm in Soil

Preliminary observations have been made on 75 pupae buried at depths ranging from 1/2" to 8" in eight soil types from medium sand to heavy clay loam contained in glass-walled observation boxes. Various soil moistures, from very low to high, were maintained by periodic watering as needed. There were only three moths that reached the surface, all through fine sandy loam from the Lubbock, Tex., area. These moths escaped in the following manner: One moth crawled along a crack created by a sprouting plant from the 3" depth, and two pushed through the loose drier soil from the 1" level. Of the latter two moths, one was normal but the other was deformed and could not fly due to its being unable to spread its wings before they dried. There was a 20% natural mortality. Three general observations were made as follows: No moths reached the soil surface if a crust due to irrigation was present; moths crawling through the loose soils wore off their scales before dying, presumedly from exhaustion; and in clay soils the adults could not push out of their pupal cases.

Ecological Investigations - ENT f3-14 (Lukefahr, Griffin, and Fife)

The life history and habits of the pink bollworm under Brownsville conditions have been thoroughly explored, as previously reported. Information on the seasonal occurrence of resting larvae in central Texas was obtained at the Waco laboratory. Eleven percent or less of the larvae in green bolls were found to be in the resting stage during July and August, but a rapid increase in resting larvae occurred in September. In October 93% or more of the larvae entered the diapause. A much lower percentage of larvae from squares than from bolls entered the diapause in September and October.

From observations made at the Waco laboratory, the decrease in infestation in central Texas in 1957 is attributed to a number of factors. Drought during the summer and fall of 1956 reduced the potential overwintering population due to lack of late-season bolls, except in a small portion of the fields which fruited late either because of

irrigations or fall rain that occurred in a few localities. Flooding from heavy rainfall during April and May of 1957, no doubt, resulted in a high mortality of overwintered larvae, especially of those in buried debris. Consequently the initial infestation in 1957 was lighter than in the past several years. By the last part of September and in October, heavy infestations developed in late bolls in some fields. Rains during September were favorable for plant growth and recurrence of fruiting in all fields. With a later-than-usual crop and unfavorable weather for harvest, there was a delay in stalk destruction and plow-under which permitted a late-season pink bollworm build-up, resulting in about an average hibernating population for the area in the winter of 1957-58.

Under laboratory conditions at Brownsville, a sugar diet for pink bollworm moths gave a significant increase in the number of eggs laid. A preliminary test conducted in 1956 with cotton growing in screen cages indicated that a nectarless variety greatly limited the pink bollworm population build-up, presumably due to the lack of nectar as food for the moths. Further tests in 1957 did not yield conclusive data, due to an unavoidably short duration of the experiment. This experiment is being conducted again in 1958.

Pink bollworms developing on potted cotton plants in bioclimatic cabinets with artificial light simulating long and short days showed that the percentage of larvae entering the diapause increased when the day-length decreased. The difference in percentage of diapause larvae between day-lengths was not influenced by temperature, humidity, and food, as these factors were the same for both long and short days. Approximately 60% of the larvae entered diapause when exposed to the 16-hour day as compared to 95% for a 10-hour day-length. Nearly half of the larval population for both day-lengths was exposed to a constant temperature of 80° F. and the remainder developed under fluctuating temperatures averaging 83.5° F., which simulated June temperatures as recorded at College Station, Tex. There was no significant difference in number of diapause larvae between the constant and fluctuating temperatures. Other investigations, currently in the preliminary stage, indicate that not only the daily period but the quality of light influences diapause of the pink bollworm.

A number of materials commonly used as emulsifiers or wetting agents were added to water in low concentrations and applied to infested seed cotton to determine if the agents would increase pink bollworm moth emergence over the rate obtained from cotton wetted with water alone. Of 15 materials screened, only one (Tween 61) appeared to have any effect on termination of the diapause.

Killing Pink Bollworms in Cotton Gin and Oil Mill Products - ENT f3-15

No work has been performed on this project since the last report. As previously reported, it has been found that the ginning operation, with

present-day ginning equipment, kills a high percentage of pink bollworms in cottonseed and that fans operating under certain specifications kill all the larvae in gin trash and oil mill linters, motes, and hulls. As new ginning equipment is developed, it will be tested to determine its effectiveness in killing pink bollworms if such investigation appears to be warranted.

Nutritional and Biochemical Studies - ENT f3-16 (Clark, Vanderzant, and Williamson)

Rearing of successive generations on casein medium: A laboratory culture of pink bollworms was started in June 1957. Larvae were reared on the casein medium in individual vials as previously reported. The insect was reared through its entire life cycle in an incubator at a temperature of approximately 85° F. and a relative humidity of 75 to 85%, with 12 hours of light and 12 hours of continuous darkness.

Nine generations have been reared to date, with results similar to that encountered with field populations. Moths laid about 175 eggs per female. There was no apparent decrease in the number of eggs laid by successive generations. The average larval period was 16 days. Female pupae averaged about 20 milligrams in weight, but there was a slight decrease in weights of males from the first to ninth generation, as shown in the table below.

	Females		Males	
Generation	Number	Average Weight	Number	Average Weight
1	46	20.3	22	17.0
2	52	21.4	50	17.0
3	106	20.7	73	16.5
4	164	20.6	147	16.1
5	51	20.2	54	15.3
6	365[a/]	18.8[a/]	--	--
7	261	19.0	254	15.3
8	214	18.9	180	15.4
9	155	20.8	153	14.8

a/ Both sexes.

Studies with D-amino acids: The amino acid medium developed in 1956 was used for the determination of the nutritive value of the D-amino acids. L-amino acids were replaced by their D analogs and growth of the larvae was observed. A few larvae became adults when D-histidine, D-methionine, and D-phenylalanine were fed, but growth was slow and the pupae were small. D-tryptophan supported slow growth to the third instar but only one larva became an adult. D-isoleucine, D-leucine, D-threonine, and D-valine could not be metabolized by the pink bollworm (see table below).

Amino Acid Added	Initial No. of Larvae	Pupae: Males Number	Pupae: Males Av. Wt. (mg)	Pupae: Females Number	Pupae: Females Av. Wt. (mg)	Per Cent Adults
D-histidine	112	41	11.8	32	13.9	66
D-methionine	119	32	11.6	33	13.6	63
D-phenylalanine	95	11	14.1	15	17.6	28
D-tryptophan	100	1	9.5[a/]	-	-	-
D-isoleucine[b/]	115					
D-leucine[b/]	103					
D-threonine[b/]	110					
D-valine[b/]	98					

a/ One only.
b/ All dead in first instar.

When certain D-amino acids were added to the complete medium at the same concentrations as their L-analogs, no detrimental effect on larval growth was noted. The amino acids thus tested were D-isoleucine, D-leucine, D-methionine, D-phenylalanine, D-threonine, D-tryptophan, D-valine, D-alanine, and D-serine. These findings might justify the use of some dl amino acids in the diet of the pink bollworm.

Mass-rearing studies: Efforts to develop methods for mass-rearing the pink bollworm on artificial media have encountered difficulty due to contamination by molds. In further experimentation, molds were controlled in nutritional media by use of 1.3% sorbic acid in conjunction with sodium benzoate and n-butyl-p-hydroxybenzoate. These media, composed basically of cottonseed meal or peanut flour, proved to be adequate for rearing the pink bollworm from egg to adult. The combination of fungistatic agents with the diets controlled any mold for approximately 15 days, even with no precautions for sterile conditions. With simple precautions, the cultures would remain free of mold for 30 to 50 days.

The methyl and butyl esters of parahydroxybenzoic acid, sorbic acid and sodium benzoate were tested for toxicity to larvae and for antimicrobial activity in pink bollworm casein media. Tests were conducted using non-aseptic procedures. Variability in egg hatch and media drying precludes positive statements with respect to larval toxicity. There is, however, an indication that some of these antimicrobial agents prolonged the duration of the larval instars. Microbial growth in the media, generally, was held to a low level.

Individual antimicrobial agents were tested for toxicity to pink bollworm larvae using aseptic procedures to minimize contamination effects. The agents were incorporated into the media and pink bollworm eggs added. Results of these preliminary tests are presented in the following table.

Agent	Per Cent Unhatched Eggs	Per Cent Dead Larvae	Per Cent Living Forms[a/]
Sodium benzoate	25	16	58
Sodium propionate	25	50	25
Sorbic acid	36	38	24
Methyl parasept[b/]	7	55	35
Propyl parasept	30	20	48
Butyl parasept	36	27	30

a/ Includes adults, pupae, 2nd, 3rd and 4th instar larvae.
b/ Parasept is a registered trademark for parahydroxybenzoic acid.

The large number of unhatched eggs may be accounted for partly by the damage sustained in the handling required for aseptic procedures. Addition of the antimicrobial agents to the media appeared to promote drying and may account for part of the high larval mortality.

Sufficient numbers of adults were reared, both aseptically and non-aseptically, with the aid of various antimicrobial agents to warrant further effort in this direction.

Preliminary amino acid, sugar, weight, fat and water analyses of the nondiapause and diapause fourth-instar larvae to determine any possible differences have been completed. It was found that the larvae contain 27 free amino acids in their haemolymph. The differences amounted to four amino acids, the nondiapause larvae having taurine while the diapause larvae had o-amino-r-butyric acid, glucosamine and fast alanine. Glucose and fructose were found in about equal amounts in the haemolymph of both types of larvae. The water content of the diapause larvae was about 3% lower than the nondiapause larvae. The wet and dry weights of the diapause larvae were approximately 12% more than the nondiapause larvae. A comparison of the analyses of diapause larvae of three age groups showed no differences in water content, but a nonlinear drop in weight and fat. The loss rate increased after the 15-month period, indicating some physiological change which raised the metabolic rate.

Light Traps - ENT f3-17 (Glick)

Work with currently available electric lamps and traps has shown that they are of no benefit in control of the pink bollworm and other cotton insects. However, work is being done by other agencies to develop lights and traps that are more efficient in attracting and killing insects. Because of the possibilities for use of such light traps to detect isolated infestations so as to aid in early eradication, and for use as a research tool, some cooperation in this work appears to be warranted.

A light trap was operated on the laboratory grounds at Brownsville throughout most of 1957 and records of the weekly insect catches were made available for the Cooperative Economic Insect Report, issued by the Plant Pest Control Division. These catches indicated that the migrating pink bollworm moth population increased through the middle of August and then decreased rapidly with the completion of cotton stalk destruction by August 31. A light trap was likewise operated at Waco, in central Texas. Very few pink bollworm moths were caught in April, May, June and July, but considerable numbers were collected in August and September and to a lesser extent in October.

Damage to Cotton Quality - ENT f3-19 (McGarr and Richmond)

Samples of cotton were collected from both the check and treated plots in insecticide tests and submitted to the local Regional Classing Office of the Agricultural Marketing Service for quality analysis. The Regional Classing Office report showed that the sample from the check plots was graded Low Middling Light Spot, 1 1/16" staple, with a value of 24 cents per pound. The sample from the plots in which the pink bollworm had been effectively controlled with insecticides was graded Strict Low Middling plus, 1 3/32" staple, with a value of 34.10 cents per pound. Micronaire readings for the check and treated samples were 3.3 and 3.6 respectively. The cotton for these samples was harvested by hand picking rather than by "snapping". Had the cotton been harvested by snapping, the grade and staple of the sample from the check plots probably would have been lower with a corresponding decrease in dollar value.

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Noble, L. W. 1957. Pink bollworm research (Progress Report, 1957). Cotton Gin and Oil Mill Press, Oct. 5, 1957.

Vanderzant, Erma S., Dundappa Kerur, and Raymond Reiser. 1957. The role of dietary fatty acids in the development of the pink bollworm. Jour. Econ. Ent. 50(5):606-608.

Manuscripts in process of publication:

Bottger, G. T., A. J. Chapman, Rex L. McGarr, and C. A. Richmond. Laboratory and field tests with Sevin against cotton insects. Jour. Econ. Ent. (in press).

Clark, E. W., A. L. Williamson, and C. A. Richmond. An improved Berlese funnel apparatus and laboratory technique for collecting pink bollworm and other insect larvae. (Jour. Econ. Ent.)

McGarr, R. L., and A. J. Chapman. Guthion versus a mixture of DDT and endrin for control of the pink bollworm and boll weevil. (Jour. Econ. Ent.)

Robertson, O. T., V. L. Stedronsky, and D. H. Currie. Kill of pink bollworms in cotton gins and oil mills. (USDA Publication)

Vanderzant, Erma S. The amino acid requirements of the pink bollworm (Jour. Econ. Ent)

Papers read at meetings but not printed:

Bottger, G. T., W. L. Lowry, and A. L. Scales. Screening tests of some organic insecticides against cotton insects. Read at Southwest Branch ESA Meeting, Houston, Tex., Feb. 10-11, 1958.

Clark, Edgar W. A comparative study of the amino acids, fats, carbohydrates and water of nondiapause and diapause pink bollworm larvae. Read at Southwest Branch ESA Meeting, Houston, Tex., Feb. 10-11, 1958.

Shiller, Ivan. The effect of burial depths on the emergence of pink bollworm in cotton crop residues. Read at Southwest Branch ESA Meeting, Houston, Tex., Feb. 10-11, 1958.

Tsao, Ching H., and G. T. Bottger. The effectiveness of Chipman R-6199 against some cotton insects. Read at Southwest Branch ESA Meeting, Houston, Tex., Feb. 10-11, 1958.

PERMANENT PERSONNEL

Brownsville, Texas

Name	Title	Assignment
D. F. Martin[1/]	Section Head	Pink Bollworm Section.
S. E. Jones[2/]	Station Leader	Coordination of pink bollworm research.
A. J. Chapman	Entomologist	Assistant Station Leader.
L. W. Noble	Entomologist	Research planning; leader, biological research; preparation of reports.
G. T. Bottger[3/]	Entomologist	Leader, toxicology research.
T. P. Cassidy[4/]	Entomologist	Flax insect research; part-time duties on pink bollworm.
E. W. Clark	Entomologist	Leader, physiological, biochemical, and morphological research.
R. L. McGarr	Entomologist	Leader, field insecticide research.
O. T. Robertson	Entomologist	Leader, cultural control.
J. M. McGough	Entomologist	Biological control and attractant studies.
R. R. Sluss[5/]	Entomologist	Insect pathology.
P. A. Glick	Entomologist	Migration and attractant studies.
W. L. Lowry	Entomologist	Toxicological research.
M. J. Lukefahr	Entomologist	Biology studies.
C. A. Richmond	Entomologist	Physiological research.
Ivan Shiller	Entomologist	Hibernation experiments; host plants.
C. H. Tsao	Entomologist	Toxicological research.
A. L. Williamson[6/]	Entomologist	Physiological and biochemical research.
J. A. Griffin[7/]	Entomologist	Insecticides and ecology.
C. N. Husman[8/]	Equip. Spec.	Equipment and machinery development.
M. A. Taylor	Admin. Officer	Fiscal administrative.
A. R. Galvan	Clerk	Fiscal administrative.
E. S. Schunter	Secy.-Steno.	Clerical

Name	Title	Assignment
S. H. Robinson[9/]	Clerk-Typist	Clerical.
F. W. Weeks	Clerk-Typist	Clerical.
E. C. Garcia[10/]	Clerk-Typist	Clerical.
L. S. Bloom[11/]	Biological Aid	Toxicology.
G. L. Griffith[12/]	Biological Aid	Field insecticides.
J. E. Houghtaling	Biological Aid	Bioclimatic cabinet studies.
Miguel Rodriguez[13/]	Biological Aid	Physiology.
Robert L. Ward[14/]	Biological Aid	Toxicology.
	College Station, Texas	
E. S. Vanderzant	Biochemist	Nutrition and biochemistry.
A. L. Williamson[6/]	Entomologist	Nutrition and biochemistry.
	Waco, Texas	
L. C. Fife	Entomologist	Hibernation and cultural control.

1/ Appointment effective 10/1/57.
2/ Promoted to Chief of Branch, Beltsville, Md., 8/10/57.
3/ Transferred to Cotton Insects Section, Tucson, Ariz., 3/9/58.
4/ Retired 1/31/58.
5/ On leave of absence, effective 10/1/57.
6/ Transferred to College Station, Tex., 9/8/57.
7/ Assigned to Brownsville by State of Alabama; assignment terminated 8/27/57.
8/ Transferred to Animal Disease Eradication Division 10/5/57.
9/ Transferred to Fruit Insects Section 5/19/58.
10/ Appointment effective 5/19/58.
11/ Resigned 8/30/57.
12/ Appointment effective 10/21/57.
13/ Appointment effective 10/21/57.
14/ Appointment effective 2/3/58.